

Scientific Note

PUPAL CASE OF *RHAPHIOMIDAS ACTON* COQUILLET (DIPTERA: MYDIDAE) AND BEHAVIOR OF NEWLY-EMERGED ADULT

Rhaphiomidas is an enigmatic genus of flies. The adults are often huge; members of this genus are among the largest flies in North America. The flying and foraging behaviors of these diurnal and conspicuous insects are easily observed and the adults are not difficult to capture. Yet very little is known of the early life stages of these flies. *Rhaphiomidas* presently comprises 25 species and subspecies, many of which are discussed by R. Rogers & R. Mattoni in their review of the natural history of the genus (1993. *Dipterological Research* 4: 21–34). Whereas adult feeding has been observed in 13 of the 25 taxa, oviposition has been seen in seven species and mating has been observed in only two.

On 19 Jun 1996, a newly-emerged male Giant Flower-loving Fly, *Rhaphiomidas acton* Coquillett and its pupal case were found in the flood plain of the Santa Ana River, about 400 m (¼ mile) north of the present riverbed, near the City of Redlands, San Bernardino County, California. This account will be only the fourth published report of pupal emergence in the genus *Rhaphiomidas* and the first to detail the flying and feeding behaviors of the newly-emerged adult.

Our discovery was made during a search for nesting sites of pollinators of the Santa Ana River Woolly Star, *Eriastrum densifolium* ssp. *sanctorum* (Milliken) H. Mason, one of the 12 most endangered plants in California (York, R. 1987. In Elias, T. Editor. *Conservation and Management of Rare and Endangered Plants*. California Native Plant Society). Our field crew had been trained to recognize *R. acton*. Specimens captured earlier from this area were identified as *R. acton acton* by John Wheeler and C. E. Jones using the revision of the genus by M. A. Cazier (1985. *Bull. Amer. Mus. of Nat. Hist.* 182: 181–263). Recently, however, one reviewer of this manuscript suggested that the specimens may actually be *R. acton maculatus* or an intergrade between the two subspecies (Rogers, R. 1998, personal communication). Thus the subspecific delineation of our observed insect remains uncertain. We would also like to note that this fly is by no means abundant in this region. In contrast to the dense populations described by Rogers & Mattoni (1993) for several species, since 1987 we have observed fewer than 25 *R. acton* individuals per acre and never more than three in a single field of view.

At 1040 PDT, a male *R. acton*, with its pupal case, was found on the surface of the collapsed entrance to a rodent burrow. In contrast to the conditions described by Rogers & Mattoni (1993) for other emerging adults, the surrounding area was dotted with shrubs and subshrubs as close as 35 cm from the hole. Otherwise the ground was open and relatively clear of debris. The temperature of the soil was 46.5° C at the surface and 40.7° C about 3 cm below the surface. Later analysis of the soil from this site enabled us to classify the substrate as medium to very fine sand with 2.0% silt and 1.7% clay. This substrate was homogeneous to a depth of at least one meter.

When discovered, the fly had damp-looking, milky-opaque wings and did not

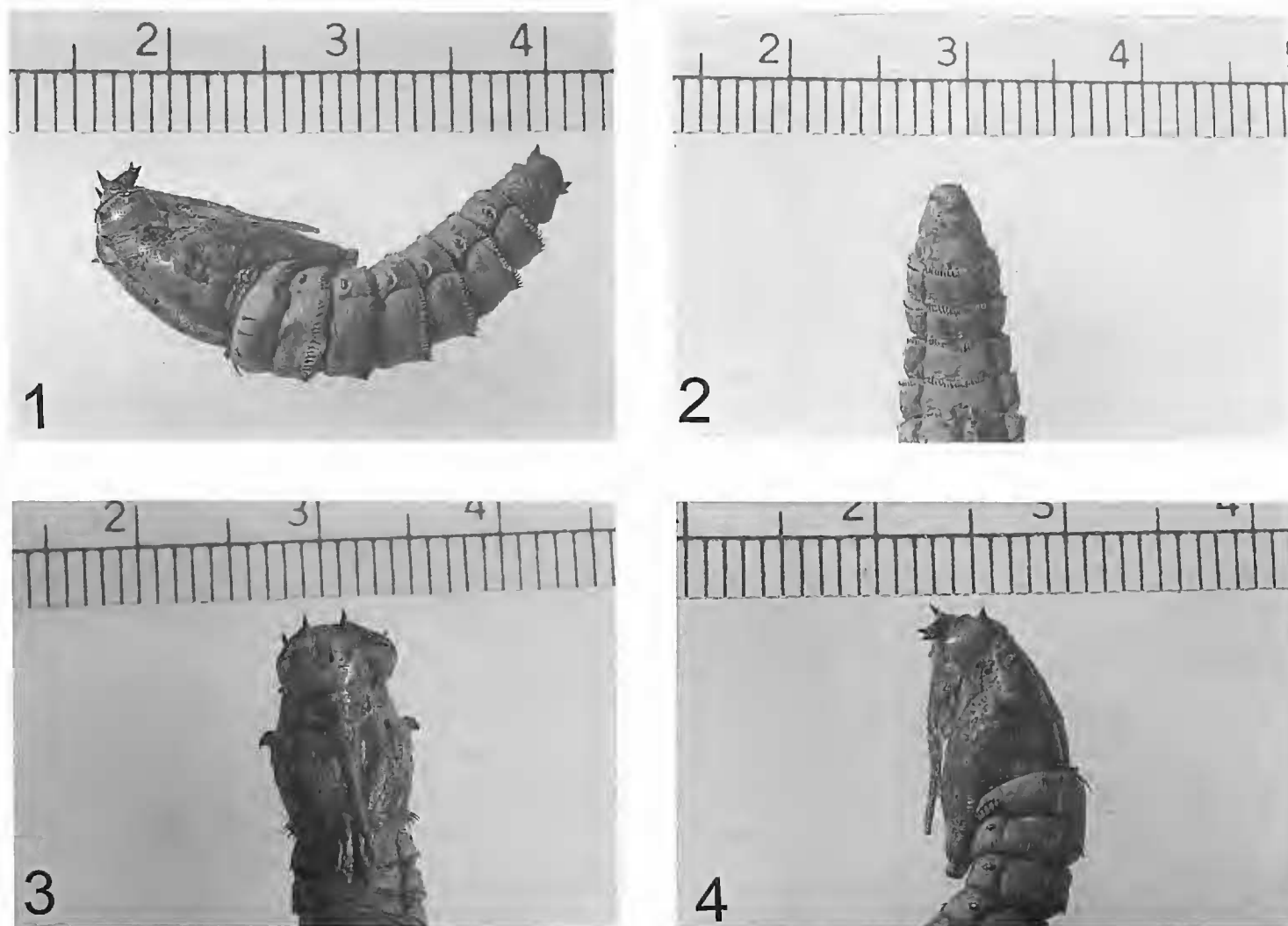


Figure 1. Pupal case of *Rhapsiomidas acton acton*. A. Lateral view of entire case. B. Ventral view of abdomen. C. Anterior/ventral view of head. D. Lateral view of head and thorax.

move when approached or touched. After 20 min, the wings were transparent and the fly began to repeatedly vibrate its proboscis and pulsate its abdomen, moving it up and down. At 1103, the fly took its first flight $\frac{1}{2}$ m to a dried *E. d. sanctorum* stem, paused, then flew another $\frac{1}{2}$ m to a blooming *E. d. sanctorum*. It did not feed, but occasionally vibrated the proboscis and pumped the abdomen. The fly, its emergence hole and the surrounding habitat were photographed. After half an hour, it flew about $\frac{1}{2}$ m to a California croton, *Croton californicus*, then about $2\frac{1}{2}$ m to another croton, and finally flew about eight m to a stand of *E. d. sanctorum* where it began to feed. The proboscis was fully inserted into many floral tubes as the fly moved from plant to plant. After five min of feeding, it flew out of sight. The pupal case was brought back to the lab of Dr. C. Eugene Jones at California State University, Fullerton, where it is currently stored in the entomology collection.

Our pupal case of *R. acton* is virtually indistinguishable from that of *R. terminatus* Cazier as described by R. L. Hogue (1967. Bull. S. Calif. Acad. Sci. 66: 49–53). With the exception of length (our case measures 35 mm long), every feature matches that in Hogue's description. There may be important differences in the pupal cases, particularly in the spines of the terminal abdominal segment (Rogers, R. 1998, personal communication) but at present, with the data available to us, we are unable to make any distinction other than length. Figure 1 shows photographs of our pupal case taken from four different angles.

To date, we have found no information on the habits or requirements of any

Rhaphiomidas larvae. Rogers & Mattoni (1993) describe hatching of eggs, in captive situations, of five species of *Rhaphiomidas* but have been unable to determine the diets of any of the larvae. In this instance and all other reports of *Rhaphiomidas* emergence, the pupal cases were discovered lying on the ground. Additionally, Cazier found a partial pupal case, possibly of *R. acton*, on the sand at Cronese Dry Lake, San Bernardino Co., California (Hogue 1967). Clearly, *Rhaphiomidas* pupates in the ground and the pupal case is brought to the surface from a greater depth as the adult emerges. However, the behavior of larvae prior to pupation is entirely unknown. In their description of newly-hatched *R. terminatus abdominalis*, Rogers & Mattoni (1993) suggest that the larvae may spend considerable time above ground.

The Giant Flower-loving Fly has been shown to be an important pollinator of the Santa Ana River Woolly Star (Burk et al. 1989. *Fremontia* 17: 20–21). Although *R. acton* is not the only pollinator of *E. d. sanctorum*, examination of pollen loads on captured insects has revealed *R. acton* to be a remarkably constant pollinator, with an average percent constancy of 94.8% (Jones, C. E. & J. H. Burk. 1997, unpublished report prepared for Psomas and Associates. 22 pages and two appendices). Understanding this insect's life cycle and its needs may be an important factor in efforts to protect this very rare plant.

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